



The importance of otoscopic examination in the hearing screening of neonates

Importance of otoscopic examination

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Abstract

Aim: Permanent hearing loss in children is congenital in more than 80% of cases. Hearing screenings of newborns are important in the early determination of hearing loss. The aim of this study was to draw attention to the importance of a careful otoscopic examination before hearing screening in newborns. **Material and Method:** In this retrospective study, the records of patients who underwent a hearing test according to the hearing screening program in our clinic between January 2015 and January 2017 were examined. Evaluation was made of patient data with findings such as vernix caseosa, impacted cerumen, serous otitis media, external otitis, and ear canal anomalies in the notes from the otoscopic examination conducted prior to the evoked otoacoustic emission (EOAE) test. **Results:** The EOAE test was applied to 1417 patients immediately following otoscopic examination. The EOAE was normal in 1266 patients, while no response could be obtained from the ears bilaterally in 91 patients and unilaterally in 60 patients. After follow-up and treatment of patients with serous otitis, ear debris, or vernix caseosa determined in the otoscopic examination, hearing loss was determined with a repeated EOAE test as bilateral very advanced in 2 patients, unilateral very advanced in 1 patient, moderately advanced in 2 patients, at 30 dB in 5 patients, and hearing neuropathy was considered in 1 patient. **Discussion:** The significant improvement in hearing loss after treatment of vernix caseosa, cerumen, and serous otitis media has shown how important the otoscopic examination as part of the initial hearing screening of newborns.

Keywords

Hearing Loss; Otosopic Examination; Cerumen; Serous Otitis Media; Otoacoustic Emission

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Introduction

Determination of hearing loss in the early stage is a significant healthcare problem in Turkey, just as it is worldwide. Therefore, the Turkish Public Healthcare Committee of the Turkish Ministry of Health started the Hearing Screening Program for Newborns in 2004, that continues to successfully run throughout the country. There are approximately 1,290,000 live births per year in Turkey and advanced hearing loss is seen in 2-3/1000 neonates. This rate increases to 4% in infants admitted to Intensive Care Units (ICU). With causes such as childhood diseases, ear infections, accidents, and the use of some medications, the rate rises to 6%. Accordingly, it is estimated that 1800 newborns per year in Turkey born with hearing loss would benefit from a cochlear implant [1].

The hearing sensitivity of an individual with hearing loss can be defined as a state which prevents development, adaptation, and especially the acquisition of communication skills. Determination of hearing loss in the early stage ensures the provision of the necessary treatment and rehabilitation services and, thus, language, academic, and psychosocial development, adaptation to the environment, and communication skills, so the individual with hearing loss can reach the level of those with normal hearing [2]. Delays in diagnosis and rehabilitation can cause a state of disability that will affect the individual throughout life [3].

In newborn hearing screening tests, the Evoked Otoacoustic Emissions (EOAE) test and/or the Auditory Brainstem Response (ABR) test(s) are used. In the EOAE method, a recording can be made originating from outer hair cells in the cochlea with a sensitive microphone placed in the external ear canal [4]. The ABR is accepted as the gold standard for hearing screening of newborns. Electrodes are placed on the infant's head and evaluation is made of the electroencephalographic waves created in response to sound stimuli applied to the ears [5].

The aim of this study, conducted on infants aged 0-2 years in our clinic between January 2015 and January 2017, was to draw attention to the importance of a reliable otoscopic examination applied before the OAE tests to inform the evaluation of the OAE results.

Material and Method

This retrospective study included 1417 infants who underwent hearing screening in the Ear, Nose and Throat (ENT) Polyclinic of Kahramanmaraş Sutcu Imam University Medical Faculty between January 2015 and January 2017. Approval for the study was granted by the Clinical Ethics Committee of Kahramanmaraş Sutcu Imam University (11-31.05.2017). Patients were excluded if there was any external ear canal anomaly, any syndrome, or if clinical information was not available.

Before the test, a careful otoscopic examination was applied to the infants by an ENT physician. Evaluations were made in respect of vernix-caseosa, impacted cerumen, serous otitis media (SOM), external otitis, and ear canal anomalies and referrals were made to audiology. For infants thought to have serous otitis media, multifrequency tympanogram (interacoustics AT 235) was applied to those aged 0-1 year, and conventional tympanogram (Impedance Audiometer AZ26) to those aged 1 year and over. Then the OAE test was evaluated using the Madsen Otometrics OAE device. The ABR (Navigator PRO Bio-logic)

test was applied to those who required a second OAE test and to those with hearing loss risk factors.

The tests were applied by an experienced audiologist in a special quiet room with the infant spontaneously sleeping in the mother's arms. A pure sound frequency of f2 65 dB, f1 55 dB was applied for the EOAE. Distortion responses were measured at 750-1250, 1250-1750, 1750-2500, 2500-3500, and 3500-4500 Hz. Criteria were selected for a response at 3db more than the sound of the signal and 3 positives from 5 frequencies were evaluated as having passed. Those with 3 negatives from 5 frequencies were evaluated as "result could not be taken". The infants with a negative EOAE test were examined again by an ENT physician and treatment was recommended for those diagnosed with serous otitis. Within 10-20 days, the EOAE and tympanogram tests were repeated. For those who did not pass the second EOAE test, the ABR test was applied. ABR stimuli were presented with alternating polarity at a rate 21,1/s via insert earphone. Presentation level began at 90 dB nHL and decreased to 15 dB nHL. For infants with risk factors such as a maternal history of febrile disease during pregnancy, hyperbilirubinemia, ventilator support, low APGAR score at birth, birthweight <1500 gr, familial history of hearing loss, or consanguineous parents, and those admitted to neonatal ICU, the ABR test was applied even if they had passed the EOAE test.

Analyses of the study data were made using SPSS version 20.0 software. Descriptive statistics of the data were stated as mean ± standard deviation (SD).

Results

In the hearing screening applied to infants born in our hospital and those referred from other centres, an emission response was obtained in 1266 (89.3%). No response was obtained bilaterally in 91 (6.4%) infants or unilaterally in 60 (4.2%).

From the total of 1417 infants, the numbers diagnosed with cerumen, external ear canal obstruction, and serous otitis media are shown in Table 1. Of the infants where no response was obtained to OAE, 40 (26.5%) were diagnosed with serous otitis and 111 (73.5%) were not diagnosed with serous otitis (Table 2). Of the 40 infants diagnosed with serous otitis media, 23 passed the OAE test the second time it was applied. The ABR test was applied to 17 infants. Bilateral hearing loss of a very advanced degree was determined in 2 patients (aged 5 months and 1 year) and hearing neuropathy was considered in 1 patient. Unilateral hearing loss of a very advanced degree was determined in 1 patient and follow-up was recommended. Unilateral hearing loss of a moderate-advanced degree was determined in 2 patients and they were fitted with devices (Table 3). In 5 patients, hearing loss was determined at 20-30 dB and follow-up was recommended. The results of the ABR test applied during follow-up of these 5 patients were evaluated as normal.

Discussion

With an incidence of 1-3 per 1000 live births, hearing loss in newborns is the most commonly seen neonatal defect [6]. It is estimated that 1800 newborns per year in Turkey born with hearing loss would benefit from a cochlear implant [1]. Hearing screening is recommended for all newborns soon after birth

Table 1. The number of patients diagnosed with SOM cerumen and vernix caseosa in the first measurements

	N	%
Total number of patients	1417	100
Test passes	1266	89.3
Test failures (Vernix caseosa, cerumen)	111	7.83
Test failure (SOM)	40	2.82

Table 2. The results of patients who did not pass the OAE test in respect of SOM

	N	%
Total number of patients	151	100
Patients diagnosed with SOM	40	26.5
Patients not diagnosed with SOM	111	73.5

Table 3. Areas of diagnosed hearing loss after the second OAE and ABR test

	N	%
Total number of patients	1417	100
Patients with no hearing loss	1410	99.5
Patients with bilateral hearing loss	2	0.14
Patients with unilateral hearing loss	1	0.07
Patients with advanced hearing loss	2	0.14
Patients with moderate-advanced hearing loss	2	0.14

Table 4. Results of the first measurements taken from patients

	N	%
Total number of patients	1417	100
Test passes	1266	89.3
Test failures (Vernix caseosa, cerumen)	111	7.8
Test failures (SOM positive)	40	2.8

Table 5. The results of patients diagnosed with SOM

	N	%
Patients diagnosed with SOM	40	100
Patients with bilateral hearing loss	2	5
Patients with unilateral hearing loss	1	2.5
Patients with moderate-advanced hearing loss	2	5
Patients thought to have hearing neuropathy	1	2.5
Patients with normal hearing	29	72.5
Patients recommended for follow-up	5	12.5

and if hearing loss is determined, the necessary medical interventions should be made within 6 months [7]. It has been shown that in children applied with the necessary interventions within 6 months, the results obtained in expressive language tests at the age of 3 years have been within normal limits [8].

In hearing screenings, the OAE and ABR tests are generally used. Movements of the middle ear and tympanic membrane are objectively measured with tympanometry. Although the OAE test is a more rapid and easier method than the ABR test, when there is debris in the external ear canal or serous otitis media, there may be errors in the test results [9]. In the first measurements made with OAE in neonatal hearing screening, the rate of test failure has been determined as 5%-20%. The reason for this is thought to be the presence of debris and amniotic fluid in the neonatal external ear canal [10]. In the current study, the rate of test failure was 10.6% and the most common cause of this was debris and amniotic fluid in the external ear canal fol-

lowed by serous otitis media; this information was provided to the patients' families; (Table 4).

Serous otitis media is the accumulation of fluid in the middle ear without any findings or symptoms of acute ear infection. By affecting middle ear functions, SOM causes conductive type hearing loss. SOM is also one of the most significant causes of reduced hearing in the paediatric age group [11]. There is great concern in the families of infants diagnosed with SOM, but previous studies have not shown any relationship between family concerns and the existing hearing thresholds [12]. Unlike the adult ear, as the ears of newborns have lower resonance properties, screenings applied with conventional tympanometry are not reliable. Therefore, high frequency tympanometry is preferred in screening programs for newborns and infants [13]. Clinically, patients should be evaluated with otoscopy, tympanometry, and audiometry. When otoscopy is applied by an ENT physician, it is diagnostic with 95% specificity [14]. In our clinic, following otoscopic examination in the neonatal period, high frequency tympanometry is used in the tympanometric examination of infants with suspected hearing loss.

In the literature, the frequency of congenital hearing loss has been reported as 0.13%-0.60% for bilateral hearing loss and 0.17%-0.38% for unilateral loss [15]. In the current study, the rate of bilateral hearing loss was determined to be 0.14% (n=2) and unilateral hearing loss at 0.07% (n=1). Previous studies conducted in the Turkish cities of Istanbul, Konya, Izmir, Bolu, Muğla, Diyarbakır, Van, and Şanlıurfa have reported hearing loss rates of 0.27%, 0.15%, 0.21%, 0.17%, 0.25%, 0.30% and 0.4%, respectively (15-22). In the current study of 1417 infants, when rates were evaluated of patients diagnosed with SOM, bilateral hearing loss was determined at the rate of 0.14% (n=2) and unilateral hearing loss at 0.07% (n=1). Of the total 40 patients diagnosed with SOM, bilateral hearing loss was determined at the rate of 5% (n=2), unilateral hearing loss at 2.5% (n=1), and a moderate-advanced degree of hearing loss at 5% (n=2) (Table 5). Despite follow-up and treatment for SOM, no improvement was seen in hearing loss in the test applied afterwards. Of the patients determined with unilateral hearing loss, the loss was determined to be in the ear with SOM. Although OAE responses are generally positive in hearing neuropathy, in 1 (2.5%) patient with a failed OAE test, because a woven formation was observed in the ABR test, the conclusion was reached that the loss could be due to hearing neuropathy. Patients with normal hearing were determined at the rate of 72.5% (n=29). In patients who failed the EOAE test because of SOM but were evaluated with normal hearing as a result of the ABR test, it is thought that a response could not be obtained in EOAE because of the negative effects of SOM on the responses. In patients where an improvement was observed in SOM after treatment and follow-up, positive responses were observed to be obtained the second time the EOAE was applied.

The role of OAE in the evaluation of hearing has been widely examined in several studies. How OAE is affected by middle ear pathologies is complex. Generally, middle ear effusions reduce or completely suppress EOAE amplitudes; negative pressures affect EOAE at around 2khz [6]. Therefore, when pneumatic otoscopic examination and tympanogram are used together in infants and children where OAE pure sound audiometry cannot

be applied, they can provide information about the status of the middle ear and can be used as a screening test.

When hearing is normal after the screening tests, the number of infants who had been referred from centres having failed the first and second tests, passed the test the third time after detailed examination and treatment, is not at a negligible rate of 0.3%-0.4% [15-22]. Psychiatric disorders such as postnatal depression and delirium are seen at the rate of 0.1%-0.2% [23]. The likelihood of hearing impairment in the infant is increased by levels of stress, depression, and anxiety in the mother, and the economic status of the family is a specific factor in respect of increased psychiatric/psychological symptoms [24].

The patients included in this study were aged 0-2 years. Since children of this age cannot inform their family of their loss of or declining hearing as older children can, a good otoscopic examination with tympanometry OAE, scanning ABR, and clinical ABR tests become more important.

Conclusion

This study underscores the importance of performing otoscopic examination before administering an initial EOAE test. In the majority of infants scanned with an OAE test without a prior otoscopic examination, the test results are negative because the evaluation has not been made in respect of serous otitis, external otitis, or debris vernix-caseosa in particular, or milk accumulated from vomiting, or. The OAE test should be repeated after 1 week following otoscopic examination. As not all screening units have screening ABR or clinical ABR test facilities, these families should be referred to a 3rd stage centre (Education and Research university hospital). However, because many mothers have postnatal depression because of the possibility of the infant being hearing impaired, the period of a week is a problematic time for parents who think they may have an infant with a disability. Even those parents who learn that their child is not hearing impaired as a result of detailed examinations and tests will have experienced psychological, sociological, and financial problems in the intervening period.

The problems described above can be avoided with otoscopic examination of the infant before hearing screening to detect and treat conditions. This is more cost-effective and spares parents the psychological stress that follows an initial negative EOAE test.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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References

- Bolat H, Genö A. Türkiye ulusal yenidoğan işitme taraması programı: Tarihçesi ve prensipleri. *Türkiye Klinikleri J E.N.T.-Special Topics*. 2012; 5 (2): 11-14.
- Kennedy CR, McCann DC, Campbell MJ, Law CM, Mullee M, Petrou S, et al. Language ability after detection of permanent childhood hearing. *New England Journal of Medicine*. 2006; 354(20): 2131-41.
- Genç GA, Başar F, Kayıkçı ME, Türkyılmaz D, Fırat Z, Duran Ö, et al. Newborn hearing screening outcomes at Hacettepe University. *Çocuk Sağlığı ve Hastalıkları Dergisi*. 2005; 48: 119-24.
- Thornton AR, Kimm L, Kennedy CR. Methodological factors involved in neonatal screening using transient-evoked otoacoustic emissions and automated auditory brainstem response testing. *Hear Res*. 2003;182:65-76.
- Jacobson JT, Jacobson CA, Spahr RC. Automated and conventional ABR screening techniques in high-risk infants. *J Am Acad Audiol*. 1990; 1:187-95.
- Kenna MA. Neonatal hearing screening. *Pediatr Clin N Am*. 2003; 50:301-13.
- Özkurt FE, Özdoğan F. Newborn otoacoustic emission hearing screening outcomes. *KBB Forum*. 2012; 11(2):23-5.
- Downs MP. Universal newborn hearingscreening- The Colorado story. *International Journal of Pediatric Otorhinolaryngology*. 1995; 32: 257-59.
- Özbek E, Atlıhan F, Genel F, Çalkavur Ş, Bayar B, Özcan M. Hearing screening test results of newborns at high risk for developmental delay. *İzmir Dr Behçet Uz Çocuk Hastalıkları Dergisi*. 2011; 1(1):1-6.
- Erenberg A, Lemons J, Sia C, Trunkel D, Ziring P. Newborn and infant hearing loss: detection and intervention. *American Academy of Pediatrics. Task Force on Newborn and Infant Hearing, 1998-1999. Pediatrics*. 1999; 103(2): 527-30.
- Sezgin Z. Otitis media with effusion: Overview of diagnosis and treatment approaches. *Pediatric Practise and Research*. 2016; 4(1):1-11.
- Stewart MG, Ohlms LA, Friedman EM, Sulek M, Duncan NO 3rd, Fernandez AD et al. Is parental perception an accurate predictor of childhood hearing loss? A prospective study. *Otolaryngol Head Neck Surg*. 1999; 120: 340-44.
- Zhidi L, Kun Y, Zhiwu H. Tympanometry in infants with middle ear effusion having been identified using spiral computerized tomography. *American Journal of otolaryngology Head and Surgery* 2010; 31: 96-103.
- Stankiewicz JA, Mowry HJ. Clinical accuracy of tuning fork tests. *Laryngoscope*. 1979; 89: 1956-63.
- Yazgan H. Four years experience in newborn hearing screening. *Van Tıp Dergisi*. 2012; 19(3): 112-15.
- Köseoğlu S, Derin S, Bozkurt S, Şahan M, Üçüncü H. Newborn hearing screening outcomes at Muğla Sıtkı Koçman University education and research hospital. *Türkiye Çocuk Hastalıkları Dergisi*. 2016; 11: 1-4.
- Celik IH, Canpolat FE, Demirel G, Eras Z, Sungur VG, Sarier B, et al. Zekai Tahir Burak Women's Health Education and Research Hospital newborn hearing screening results and assessment of the patients. *Türk Pediatri Ars*. 2014; 49: 138-41.
- Aricigil M, Ulutaş AR, Yücel A, Arbağ H. Newborn hearing screening results. *Selçuk Tıp Derg*. 2015: 121-3.
- Özkurt FE, Özdoğan F. Newborn otoacoustic emission hearing screening outcomes. *KBB-Forum*. 2012; 11: 23-5.
- Tatlı MM, Bulent Serbetcioglu M, Duman N, Kumral A, Kirkim G, Ogun B, et al. Feasibility of neonatal hearing screening program with two-stage transient otoacoustic emissions in Turkey. *Pediatr Int*. 2007; 49: 161-66.
- Yılmaz B, Küçükbayrak B. Newborn hearing screening results, Bolu; Türkiye. *Abant Med J*. 2013; 2: 204-7.
- Oğuzhan O, Özbey AO, Yıldırım Y, Altınışık M. Newborn hearing screening results. *Kafkas J Med Sci*. 2016; 6(3): 181-85.
- Akdeniz F, Gönül AS. Kadınlarda Üreme Olayları ile Depresyon İlişkisi. *Klinik Psikiyatri*. 2004; 7(suppl 2): 70-4.
- Murat Doğan. Comparison of the Parents of Children with and without Hearing Loss in Terms of Stress, Depression, and Trait Anxiety *International Journal of Early Childhood Special Education (INT-JECSE)*. December. 2010; 2(3): 231-43.

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